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(54) Title: METHOD FOR MORTGAGE AND CLOSED END LOAN PORTFOLIO MANAGEMENT

(57) Abstract

A method for mortgage and closed end loan portfolio management in the form of an analytic tool designed to improve analysis of past and future performance of loan portfolios. In accordance with one aspect thereof, the invention aggregates loan units into loan vintages, wherein the loans in each vintage originate within a predetermined time interval of one another. The invention compares different vintages to one another in a manner such that the ages of the loans in the different vintages are comparable to one another. An early warning component of the system predicts delinquency rates expected for a portfolio of loans during a forward looking time window. A matrix link component of the invention combines the loan vintage analysis with the early warning component of the invention and predicts the default rate of the loan portfolios at a selected future point in time. The results of the analysis are graphically depicted and/or automatically fedback to provide "yes" or "no" decisions regarding investments in various loan portfolios.

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METHOD FOR MORTGAGE AND CLOSED END LOAN PORTFOLIO MANAGEMENT

BACKGROUND OF THE INVENTION

The present invention relates to banking and, more particularly, to a loan performance analytic tool designed to improve analysis of past and future performance of loan portfolios.

Financial institutions such as banks own large portfolios of mortgage and other closed end loan instruments. Further, there is a constant influx of applications for new loans and mortgages and, moreover, existing loans are treated by banks as commodities or products which they trade among themselves. Banks underwrite loans and/or purchase loan portfolios of other banks or sell portions of their own loan portfolios. In doing so, banks customarily continually assess and reassess the quality of various loan portfolios, which quality depends on the interest rates earned on those loans, the customer payment history on the loans and other criteria.

As regards newly originated loans, the process begins with loan applicants submitting applications to financial institutions which then triggers an

investigation by either the bank and/or related service organizations which check the credit history of the applicant before the loan is approved. Typically, the decision to grant or not grant a loan implicates various credit screens that examine such factors as the loan to value ratio (LTV) of the particular application or the debt to income ratio (D/I) of the applicant and other historical facts, which shed light on the commercial worthiness of the given loan transaction. Once a loan is granted, it becomes part of an aforementioned vast portfolio of loans which a given financial institution owns and/or services. The "quality" of the particular loan heavily depends on the interest fees earned by the financial institution on each loan and on the performance of the loan which is dependent on the timeliness of the payments by the loan applicant and/or on loan prepayment.

Loan portfolios represent to banks two separate and distinct lines of business or sources of income. One business line or source of income flows from the ownership of the loans and the earning of interest fees thereon. The second line of business involves the servicing of the loan, for example, the keeping of records, collection of periodic payments, enforcement in the form of loan foreclosures, etc. Banks can earn fees on servicing of loans which they either own outright or

which they service on behalf of other financial institutions. This is because it is traditional in the banking industry to attribute to each loan a basic cost of servicing which is included in the interest fees charged to the customer. If a bank is able to carry out or perform these servicing tasks at a cost structure which is below the originally attributed servicing cost, the bank is able to realize a profit from its loan servicing business.

It is not uncommon for large financial institutions to immediately turn around and sell to other investors portions of the loans that they have booked, to spread the credit risks and in order to diversify the types of loan instruments that they are holding. The same is true of the services end of the business with respect to which decisions are constantly made as to whether retain or sell the servicing components of various groups of loans.

The loans that are retained for servicing are assigned to a subsidiary of the financial institution which is a purely service organization that has developed the methodology and procedures for servicing loans. A portion of the loan portfolio can be sold to third party loan servicing bureaus. It is common for banks which sell loans to retain ownership of the servicing rights to

earn the fee income thereon. In addition, many financial institutions may decide to purchase servicing rights from other financial institutions.

In any case, bank managers are responsible for managing loans totalling billions of dollars both as pure loan instruments and as products that require servicing. The decisions whether to retain different groups of loans or whether to sell them off to other investors and, on the other hand, whether to purchase loan portfolios from other institution for ownership or servicing purposes are bottom line decisions that have the potential to affect the financial institution's profits and/or losses to the tune of tens or even hundreds of millions of dollars. Hence, loan portfolios are constantly examined by bank managers very carefully since different vintages of loans can perform quite differently from one another.

For example, a portfolio of loans representing mortgages granted in a particular locality during a particular time frame might be deemed to represent high quality loan instruments, as for example in the situation where the history of these groups of loans has shown that the rate of default for that group of loans has been extremely low and the interest rate on those loans is high compared to present interest rates. Conversely, another portfolio of loans granted in another region of

the country which may have suffered economic decline may result at some future date in large rates of default. Assuming further that these loans were issued at a low interest rate, it is not difficult to understand that the particular "product" -- the portfolio of loans -- would be deemed to possess low value and be a good candidate for being sold. Alternatively, a shrewd bank manager might see future value in a presently poorly performing loan portfolio and seek to buy at its current low price structure for its potential improvement. In the same vein, the "servicing" of such loans may be more difficult and expensive due to higher default instances. A bank might wish to sell off the ownership component of such a loan portfolio, or the servicing rights thereof, or both. Sometimes, however, a financial institution which has a "servicing" subsidiary that is being underutilized may be willing to accept loan portfolios of servicing rights considered unattractive by other financial institutions.

In the prior art, bank managers entrusted with making the aforementioned decisions have often resorted to and relied on manual research and their intuition in their attempts to predict, manage and select loan portfolios for ownership and servicing purposes. The prior art approach has failed to provide a straightforward and easy to comprehend and administer

system for assessing the past performance and future likely course of loan instruments.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a system and method which improves the understanding of the past performance of loan portfolios.

It is another object of the invention to provide a system which enhances the ability of financial institution managers to choose which mortgage and other debt instrument applications to underwrite.

Yet another object of the present invention is to provide a system and method which enhances the ability of financial institution personnel to make decisions whether to retain or dispose of different groups of loans.

It is also an object of the present invention to provide a system and a method which is able to dynamically and automatically evolve loan underwriting criteria.

It is yet another object of the present invention to provide a dynamic underwriting model which is capable of being implemented in a general purpose computer.

It is also a further object of the present invention to provide a system and methodology which enables automatic processing of loan applications through a system that feedbacks information from a dynamic processor and which allows loan acceptance decisions to be made automatically and rapidly.

The foregoing and other objects of the invention are realized by a system and process which is tailored to analyze and select loan portfolios for either continued or future investment by a financial institution. Each loan portfolio comprises a plurality of loan units and the system operates by separating the loan portfolios into a plurality of loan vintages, in a manner such that the loans included in each loan vintage have origination dates that are on average of the same age. The system of the invention produces an analysis of the past performance of loan portfolios, as well as an indication of the future performance thereof in two different formats.

As to past performance, the invention develops the loan vintages in a manner such that vintages of different years can be compared to one another meaningfully because the loan units in each of the different vintages are actually of the same comparative ages. For example, when 1993 and 1994 loan vintages are

compared, the loans units that are being compared are of the same age to provide more meaningful comparisons. This is referred to in the ensuing description as the Crus Classes analysis system. In one embodiment of the Crus Classes system, output results are graphically depicted by means of a curve which represents the difference between the delinquency rates of loans in the two yearly vintages. To improve the reliability of the results, an area of uncertainty is superimposed over the difference to allow users to focus their analysis on those locations on the difference plot which lies outside the area of uncertainty. This increases the reliability of the analysis and the ability to trust its results. The area of uncertainty can be calculated as a +1 and -1 standard deviation, but the actual size thereof is a matter of personal choice.

The early warning system (EWS) constituent of the invention is one of the systems and processes which predicts the percentage of the loans in a given loan vintage which are likely to enter a "bad" state within a predefined forward looking time window, for example, the next two years. The prediction is calculated by using a logistic regression formula which has been developed in part on the basis of the analytic results obtained from the Crus Classes analysis component of the invention.

Finally, the so-called matrix link component of the present invention is generally similar to the aforementioned early warning system in that it is a prediction tool. It differs from the early warning system in the respect that it is capable of forecasting the percentage of loans that are likely to be bad at a date certain within the aforementioned forward looking time window. In all cases, the results of the analysis can be graphically depicted by comparing vintages to one another, using various curves, bar charts and the like in a manner described herein. For imposing the integrity of the results it is desirable that the number of loan units in the analysis be large, preferably in the hundreds of thousands of loan units and preferably at least 50,000 loan units.

As a general note and definition applicable to throughout the present specification and claims, the term "loan portfolios" means, includes and/or refers to booked loans, applications for loans for which underwriting decisions have to be made and the aforementioned loan servicing rights.

Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an overall block diagram of a dynamic underwriting system and method in accordance with the present invention.

Fig. 1A is an explanatory chart which shows an example of the delinquency rates of various loans by vintage year for a given loan portfolio.

Fig. 1B is a tree chart and exemplar of an actual family of different types of loan groups and shows the rate of delinquency associated therewith.

Fig. 2 illustrates a prior art method for assessing the profitability and performance of a portfolio on a yearly vintage basis.

Fig. 3 illustrates a novel method of assessing the past performance of loan portfolios based on yearly vintages in accordance with the present invention.

Fig. 4 is a graphic that illustrates a method of the present invention involving assessing the relative value of different vintage loan portfolios.

Fig. 4A is a table which illustrates calculations performed to obtain data for the graphic of Fig. 4.

Fig. 5 illustrates a further graphical method of the present invention for showing both the past

performance and the future predicted performance of loan portfolios.

Fig. 6 is an explanatory graph provided for explaining how a portion of the graph of Fig. 5 is obtained.

Fig. 7 illustrates the format of a roll rate delinquency table for one year which is used in the matrix link analysis module of the present invention.

Fig. 8 is a table which shows the methodology and equations used in forecasting bad rate probabilities in the matrix link component of the present invention.

Fig. 9 is a plot of the final results obtained with the matrix link component of the present invention.

Fig. 10 is a hardware/software block diagram of key components of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

By way of background and introduction, the general environment for the method and system of the present invention can be better appreciated by initial reference to Fig. 1. As illustrated therein, home buyers and refinanciers 12 typically submit applications for loans to one or more financial institutions 14. These institutions include loan granting departments that decide whether or not to book given loans by applying

various credit screens, i.e. criteria. One screen may focus on the applicable LTV (loan to value) of a transaction, the D/I (debt to income) ratio of the involved transaction and/or on the credit history of the particular applicant.

Based on the aforementioned and other criteria, a decision is made to accept or reject a particular loan application. Each loan that has been accepted is added as another loan unit to a large portfolio of similar families of loans, e.g. conforming loans, jumbo loans, government loans, etc. A loan has typically a loan start date and a date by which the loan is expected to be fully paid up, as is typical of home mortgage loans. A loan that is issued for a fixed amount and period of time is known in the trade as a closed loan. These closed loans 16 are artificially split and treated as two business securities or entities -- namely as a "loan" entity and as a "servicing" right, as indicated at 32.

Each loan unit or instrument represents to the financial institution an opportunity to earn a profit on the differential between its cost of money and the amount of interest earned from the borrower. Another profit component is realizable from the servicing element of each loan entity. That is, a finite budget for labor and equipment use must be allocated when the loan is issued

to service each loan over its life time. The banking trade has traditionally derived substantial revenues from the servicing of loan portfolios, to the extent that they were able to service loans at a cost below the originally calculated service allocation. Consequently, banks and other financial institutions sometimes trade loan "servicing" contracts. These contracts are routinely purchased and sold in large units since they represent income opportunities. For example, a bank which lacks a servicing department might contract with another bank to service its loans at a set, per loan pricing arrangement. The bank that purchases the contract does so with the expectation of earning a profit on the project. If it develops later that a particular loan portfolio experiences a large rate of defaults, the extra servicing needed to collect funds on the loans might render the particular servicing contract unprofitable. In such a situation, the service organization might attempt to resell the service contract to another service organization which might be interested in it, for example, at an increased service rate.

With further reference to Fig. 1, block 18 represents the department of the financial institution which makes the decision whether to retain or sell a particular loan portfolio. Typically these loans are

sold in very large blocks, each containing thousands of individual loan units. Those loan units originating at block 12 which are retained by the given financial institution are represented by block 20. On the other hand, as indicated by the block 22, a portion of the book of loans is sometimes sold off to investors and is securitized. Therefore, it will be appreciated that selling and purchasing loan portfolios requires careful examination of various loan product lines to assess their viability, profitability and related factors.

As already noted, another source of profit flows from the servicing portion of the loans. Block 24 identifies the step which decides whether to retain or sell the servicing component of a loan portfolio. Those loans for which servicing is retained are serviced at the bank which originated the loans as indicated at 26. The servicing of the balance of the loans procured at block 14 is contracted out to third parties for services as indicated at block 28. In addition, the servicing end 26 of the banking business is also able to purchase the servicing rights as indicated at 32.

As described, the banking industry distinguishes between ownership of loans and the servicing thereof. Loans that are owned by a given financial institution can be serviced by that

institution's own servicing subsidiary or the servicing part can be contracted to third party servicing bureaus. Indeed, not all financial institution have loan servicing departments. Conversely, a bank with a servicing organization can purchase the "servicing" component associated with loans owned by other banks and render the servicing thereon.

In any case, it is self-evident that the profits from earning interest on loan portfolios and from the loan servicing line of business is heavily influenced by the performance of various loan groups vis-a-vis the default rate of these loans over the life of the loans, foreclosures, collection efforts, loan prepayment and the like. Loan portfolios which experience low default rates are easy to service and are highly profitable to financial institutions.

Traditionally, the decision to purchase, retain, sell or create loan portfolios demands critical analysis of the past performance of the loan portfolios under consideration. Moreover, such decisions invariably implicate assumptions and predictions as to how such loan portfolios will perform in the future. Not surprisingly, the decisions to book loans at block 14 typically depended on and required analysis and consideration by highly skilled and experienced persons having very keen

and sharp analytical powers to determine the potential profitability of loan portfolios being considered.

The present invention departs from the prior art by providing a dynamic underwriting method and system 30 comprising several key components including an early warning system 32, a Crus Classes analysis section 34 and a matrix link 36, all to be described further on. Essentially, the information obtained from the subsystems 32, 34 and 36 is designed to be applied, via feedback line 38, to the decision box 14 in a manner which systemizes and provides a standardized approach to forming the decisions whether to book loans. The invention substantially increases the reliability, consistency and speed of the loan acceptance decision process. Further, the dynamic underwriting system 30 of the present invention can also be applied via feedback line 40 to the decisional box 32 which addresses the decisions at block 32 whether to purchase loan servicing rights of loans owned by other financial institutions. Finally, the feedback line 41 provides feedback for forming the decisions identified in blocks 18 and 24.

The invention shall now be described with respect to the subcomponents of the invention, including the aforementioned subsystems 32, 34 and 36, beginning first with the Crus Classes component 34.

Experience has shown that the past performance of a group of loans is often a key indicator of its future behavior. Therefore, the first step in the analysis process focuses on providing an improved analytical tool for the examination of the loans' past performance. This is the function provided by the Crus Classes system 34. The Crus Classes subsystem 34 essentially represents a fresh approach to the analysis of the prior performance of already booked groups of loans. The early warning system 32 is a forward looking system which comprises a method and process that is able to predict what portion of the overall number of loans in a particular loan group will experience 90+ day tardiness in payments by the borrower(s) thereof at anytime within a predefined time period, for example, the next two years. By way of example, if the system predicts that thirty loans out of a thousand in a given loan portfolio will experience 90+ day delay in payment at any time within the next two years, the EWS (Early Warning System) 32 will return the value .03 to indicate that it expects 3% of the loans in the given group to go "bad" at least once during the predefined time period. Finally, the matrix link component 36 provides a more sophisticated analytical model, in that it not only assigns a probability to how many loans will enter a 90-day default

but, moreover, calculates the expected number of loans in default on a specific future date.

Turning first to the Crus Classes system 34, a common technique used in credit risk management in the mortgage industry is to group loans by common intervals of origination, e.g. annually, to compare their performances. For example, the mortgage industry might typically wish to analyze the performance of 1994 vintage loans. Vintage in this context means all loans that have been originated in 1994. The classification of loans into yearly vintages by the prior art has often resulted in significant distortions of analytical conclusions. Unlike wines for which classification into yearly vintages makes sense, lumping all loans originating in the same year into a same "vintage" distorts results because there are several exogenous factors which affect how these loans perform and these factors intrinsically vary over time in a manner which can produce significant quarterly, and even monthly loan performance fluctuations.

The present inventors have opted to use the term "Crus Classes" for its similarity to the wine industry. But Crus Classes, as used herein, differs from and departs from the prior art approach of grouping loans by annual origination dates. The invention overcomes

some of the statistical inaccuracies associated with the prior art's attempts to lump loans into yearly vintages solely on the basis of the origination of a loan in a given year.

Traditional vintage techniques in the mortgage industry allow bankers to gauge the quality of mortgages as they are "aging". However, the inventors have added certain statistical procedures, such as hypothesis testing, used in the process control manufacturing environment, that allow the method of the invention to test for the statistical significance of the differences in performance among the "vintages". The result and benefits of the Crus Classes method to be described below is that it provides several advantages over the typical, prior art vintage analysis. For example, it incorporates a measure of dispersion. Further, it sets an analysis interval time shorter than a year to increase accuracy. This produces several advantages over traditional vintage analysis: (1) it automatically adjusts the comparison to account for different numbers of loans and for different size loans; (2) the Crus Classes method also allows management to set the confidence intervals; and (3) it automatically adjusts the year-to-year comparisons for loans with different credit volatility.

However, prior to describing the specific features of the Crus Classes method of the present invention it is worthwhile to introduce the following background information. Mortgage companies are vitally concerned with the performance of the loans they service and own. Active management of any loan portfolio requires the information needed to properly categorize the performance of the underlying loans. On an extremely broad and wide-sweeping comparison, delinquency rates are generated and compared to various classes of mortgage loans and summarized on a national level.

It is common in the industry for different financial institutions to share data about the total number of loans serviced by them and the appropriate number of loans that are in some form of delinquency. Delinquency categories or "buckets" range from the least serious, e.g. one payment past due, to the most serious category -- namely, in foreclosure. The following is an example prepared by the MORTGAGE BANKERS ASSOCIATION of a delinquency chart:

Total Loans Serviced or Outstanding of	1 Payment Past Due or 30 Days of	2 Payments Past Due or 60 Days of	3 Payments Past Due or 90 Days of	Loans in Foreclosure or P/C of	Total Loans Delinquent or Total of
22,428,005	733,330	163,710	141,284	230,988	1,269,312
% Delinquent	3.27%	0.73%	0.63%	1.03%	5.66%

Presenting delinquency performance in this manner is helpful in quantifying total delinquency, but it reveals nothing about the endogenous factors contributing to the default performance of the underlying loans. These endogenous factors which affect the performance of loan portfolios include, but are not limited to, some form of:

- Performance history or age of the loan,
- remaining time to maturity,
- loan amount,
- interest rate,
- borrower's credit worthiness,
- geographic locations, and
- underlying collateral type.

However, the effect of "age" on the performance of loans is a main factor that mortgage originators use to discern whether a group of loans was (or is) "good" or "bad".

The vintage of the loan refers to the time when the given loan or family or group or set of loans has originated or has been placed on the books of the lending institution. In the mortgage industry, loans are categorized by year of origination, where all of the loans originated between January 1, 1996 and December 31, 1996 are referred to as '96 vintage loans. The yearly vintages and their corresponding delinquency rates are

compared to each other to estimate relative performance and value. Fig. 1A is an example of one such vintage chart listing multiple vintages. This is a snapshot taken at the last quarter of 1996. Therefore, the oldest 1995 vintage is twenty one months old. In the figure, the 1995 curve shows a delinquency rate on the order of about 3% for the 1995, twenty one month old vintage. In contrast, the 1994 vintage curve shows a delinquency rate approximately one half the size of the 1995 vintage for the same twenty one month vintage. The mortgage default rates of Fig. 1A significantly affect future loan performance. Indeed, a single percentage rise in the delinquency rate represents many millions of dollars in losses to the typical financial institution which carries a very large portfolio of loans.

Further by way of background, mortgage loan portfolios are quite heterogeneous, with many subtle and changing variations in the basic product characteristics and behavior. An important consideration in the methodology of the present invention is the evolvement of a model that preserves the heterogeneous nature of the mortgages. Therefore, the inventors have grouped the mortgages by various (endogenous) characteristics and made inferences about the relationship between each of these characteristics and the resulting level of default.

A large number of characteristics results in an extremely large number of combinations of groups to consider.

Fig. 1B illustrates the significance of maintaining proper distinction lines between various loan instruments based on origination. Thus, Fig. 1B shows for a given financial institution a total loan portfolio value of, for example, several billions of dollars, with respect to which the overall rate of delinquency is .86% (at tier 11 of the loan tree of Fig. 1B). However, for proper analysis the invention divides that loan portfolio into loan types including "conforming", "jumbo" and "government" (originated) loans, as indicated at tier 13. Note that the overall rate .86% of default is the weighed average of the delinquency rate which varies from 1.25% for conforming loans, .55% for jumbo loans, and 9.98% for government originated loans. Still further, each of the broad categories of conforming, jumbo and government loans are further divided (at tier 15) into ARM (adjusted rate mortgages) and fixed loans. Note the significant divergence in the rates of default. The same is true for the next subdivision (grouping) which hierarchically separates the third tier loan groups into low LTV loans and high LTV loans. For example, a government, ARM and low LTV loan at tier 17 has a rate of default of 0%, whereas a government, fixed and high LTV loan indicates

(for the sample shown in Fig. 1B) a delinquency rate of 13.51%.

The invention applies the Crus Classes method on each node of the loan tree shown in Fig. 1B and then runs a hypothesis test to see if the performance of each year vintage is better, worse or statistically the same (at a confidence level of one standard deviation). It is estimated that there are 308 different combinations and that it takes approximately 100 megabytes of computer storage memory to analyze and graph the results for the model shown in Fig. 1B.

Analysis of past performance of loan portfolios requires making a decision as to what constitutes a delinquent or "bad" loan, as for example for the purposes of creating a chart such as in Fig. 1A. In an embodiment of the invention which has been reduced to practice a first selection was to choose the definition of a "bad" loan. It was chosen to represent a loan on which interest and principal payments were at least 90 days delinquent. That is, loans which are non-accruing or non-performing for a period greater than 90 days are deemed "bad".

Further, since the industry is accustomed to and prefers to refer to the "vintage" of a group of loans, for example 1993 vintage, 1994 vintage, etc., the

Crus Classes method 34 also produces and presents its results in terms of loan vintages. But, it groups and selects vintages differently than the prior art.

The difference in "vintage" selection can be appreciated from the matrix tables of Figs. 2 and 3. The abscissa axis 50 in Fig. 2 indicates the yearly quarter of origination, for example, March '93, June '93, etc. The ordinate axis 52 indicates the end quarter of a group of loans, for example, June '96, March '96, March '95, etc. The matrix data in Fig. 2 indicate the number of months that have elapsed from the quarter of origination to the end point. For example, a loan originating in March '93 is 36 months old in March '96 as indicated by reference numeral 54. Similarly, a loan originating in June '93 is 15 months old in June '94 as indicated by reference numeral 56.

The approach of the prior art has been to select and aggregate as 1993 and 1994 loan vintages all of the loans between the bracket lines 58 and 60 for the respective years 1993 and 1994. Carefully comparing the precise ages of the 1993 and 1994 vintage loans reveals two aspects which may undermine and distort the comparisons. First, the traditional approach reflected by Fig. 2 compares loans whose ages differ on average by twelve months. Indeed, some of the 1993 loans which are

thirty six months old (see reference numeral 54) are two years older than the twelve month old 1994 loans (reference numeral 55). The above approach skews the results considerably since the performance of loans is very age sensitive as can be appreciated from Fig. 1A. It is far more meaningful to compare loans of the same age which originate in different years. Therefore, it is far more relevant to be able to compare the performance of different loan vintages, as of the time when they were at the same ages. For example, in seeking to answer the question: which loan vintage 1993 or 1994 is better, it is more relevant to know and compare the comparative performances of the above noted loan vintages when each was, for example, two years old. The Crus Classes method 34 of the present invention is able to do so.

With reference to Fig. 3, the present invention selects as the 1993 and 1994 loan vintages, those loans which are bracketed by the diagonally extending lines 62 and 64. In the selection method according to the present invention, the ages of the 1993 and 1994 loan vintages that are being compared are identical to one another. For example, for the year 1993 the ages of the loans vary between 6 months to 24 months and the same is true of the loans in the 1994 vintage year.